

Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

84 Mr
p. 15

**AN ANALYSIS OF SOME METHODS
OF
LOADING OUT DELIVERY TRUCKS
OF
PRODUCE WHOLESALEERS**



**UNITED STATES DEPARTMENT OF AGRICULTURE
PRODUCTION AND MARKETING ADMINISTRATION**

Washington, D.C.

May 1952

PREFACE

The study on which this report is based is part of a larger research project on the physical handling of various types of packages of perishable produce at various stages in the marketing system. The over-all study is being conducted under the general supervision of William H. Elliott, staff assistant for marketing facility and materials-handling research, Marketing and Facilities Research Branch, Production and Marketing Administration. This is the fifth preliminary report issued to make available to industry groups some of the results of the research prior to the completion of the project.

The cooperation and assistance given by many individuals and organizations in the fresh fruit and vegetable distributive industry in preparing this report is acknowledged. The authors wish especially to thank the fresh fruit and vegetable wholesalers and warehouse superintendents who made available their time, personnel, facilities, and equipment and who offered many suggestions.

Frederick C. Winter, assistant professor of industrial engineering, Columbia University, and consultant to the Marketing and Facilities Research Branch, was very helpful in his suggestions. Acknowledgement is made to Frederick J. Miller who assisted in conducting the time studies of some of the operations discussed.

Other reports on studies of materials handling of perishable food products issued by the Marketing and Facilities Research Branch of the Production and Marketing Administration are:

How Fresh Fruit and Vegetable Distributors Can Get
More Out of Their Materials-Handling Equipment,
June 1950.

Use of Recording and Transcribing Equipment in Loading
Delivery Trucks of Produce Wholesalers, May 1951.
Agriculture Information Bulletin No. 43.

The Comparative Efficiency of Current Methods and Types
of Equipment Used for Receiving Field Boxes of Apples
at Storage Houses in the Pacific Northwest Area,
January 1952.

A Portable Mechanical Lift for High-Piling and Breaking
Out High-Piled Boxes of Apples, May 1952.

- - o o o - -

The study on which this report is based was conducted under authority of the Agricultural Marketing Act of 1946 (RMA, Title II).

CONTENTS

	Page
Summary	iii
Introduction	1
Some methods used to load out delivery trucks of produce wholesalers	3
Method A - Use of low-lift platform trucks, dead skids, and belt conveyors	3
Method B - Use of two-wheel hand trucks, semilive skids and jacks, and belt conveyors	7
Method C - Use of semilive skids and jacks and elevating and horizontal belt conveyors	11
Method D - Use of fork-lift trucks and pallets, and belt conveyors	15
Method E - Use of four-wheel hand trucks, fork-lift truck and pallets, gravity conveyor, and manual handling	19
Method F - Use of four-wheel hand trucks	22
Comparison of methods for loading out delivery trucks	28
Devices and techniques for improving loading-out methods	34
Conveyor equipment	34
Flexible crew arrangement	35
Split packages	36
Loading the conveyor belt	38
Illuminating the bodies of delivery trucks	38
Working conditions	38
Recording and transcribing equipment	39

SUMMARY

In recent years, service wholesalers of produce have vigorously sought ways of reducing the costs of handling products through their warehouses. They are placing considerable emphasis on solving the problem of reducing the cost of assembling orders and loading trucks, because these are the most costly of all warehousing operations on a tonnage basis.

As used in this report, the term "loading out" refers to the cycle of operations performed in: (1) Removing produce from storage (either permanent or temporary), (2) transporting the produce from the storage point to an area near the tail gate of the delivery truck, and (3) loading the produce onto the truck. For the purposes of this discussion, the first two of these operations together with the splitting of packages are in the aggregate known as "assembling" produce. Although the three operations in the cycle are, in the majority of the methods studied, usually performed in sequence, assembly operations are separated from the truck-loading operation by the temporary placement of produce at the tail gate of the truck.

Six methods used by produce wholesalers employing different types and combinations of types of materials-handling equipment for loading out are described in this report.

Method A - Use of low-lift platform trucks and dead skids for assembling, and of belt conveyors for loading.

Method B - Use of two-wheel hand trucks, semilive skids, and jacks for assembling, and belt conveyors for loading.

Method C - Use of semilive skids and jacks for assembling, and of elevating and horizontal belt conveyors for loading.

Method D - Use of fork-lift trucks and pallets for assembling, and belt conveyors for loading.

Method E - Use of four-wheel hand trucks, fork-lift trucks, and pallets for assembling, and of gravity conveyors and manual handling for loading.

Method F - Use of four-wheel hand trucks for both assembling and loading.

In analyzing the comparative efficiency of these six methods, it was found that the labor and equipment costs of loading out produce were lowest in the warehouse using Method F (four-wheel hand trucks) -- 5 percent lower than in the warehouse using Method D and 37 percent lower than in the warehouse using the highest cost method (Method E). The direct costs of loading out a ton of produce by the six methods used in the warehouses were:

Method A	\$2.18	Method D	\$1.50
Method B	1.58	Method E	2.27
Method C	2.20	Method F	1.43

In order to make the costs comparable for all the warehouses, a wage rate of \$1.50 per hour for all labor was assumed. Per-hour equipment costs include costs of ownership and operation. These combined costs per hour of use for the types of equipment used are: (1) Two-wheel hand truck, 0.40 cents; (2) four-wheel hand truck, 0.71 cents, (3) semilive skid and jack, 0.73 cents; (4) dead skid and low-lift truck, 0.55 cents; (5) gravity conveyor, 0.33 cents; (6) belt conveyor (30 feet), 36 cents; (7) elevating belt conveyor (10 feet), 20 cents; (8) hand low-lift platform truck, 41 cents; (9) industrial low-lift platform truck, 76 cents; (10) industrial fork-lift truck, 76 cents; and (11) pallets (per 100 pallets), 4.6 cents. Ownership costs are based on present prices of the equipment, and operating costs on typical annual hours of use per item of equipment.

Labor costs were lowest when Method D (fork-lift trucks, pallets, and belt conveyors) was used--16 percent less than in the warehouse using Method F and 44 percent less than in the warehouse using the poorest method (E). Equipment costs are lowest for Method F (four-wheel hand trucks) and highest for Method A.

On the basis of these costs service wholesalers could reduce their loading-out costs, where existing facilities are suitable, by shifting to Method F. A plant currently loading out 50 tons of produce daily under Method E could, by shifting to Method F, save approximately \$13,000 annually.

After a method for loading out has been established in a warehouse, the production rate for the method in most instances can be increased by use of one or more devices. Among these are the following: Where conveyors are a part of the equipment use the cantilever type of belt conveyor for the section extending from the platform into the truck; affix to the end of the belt conveyor inside the truck a 3-foot section of gravity-type roller conveyor with a stop at the end; standardize the size of less-than-package lots that will be sold so that the day crew can pack them; use a number of bins constructed on skids or four-wheel hand trucks for package splitting operations; furnish the checker with a properly constructed stand on casters, on which to place invoices; make certain that the work area inside the motortruck is well lighted; and replace the checker with recording and transcribing equipment.

AN ANALYSIS OF SOME METHODS OF LOADING OUT DELIVERY
TRUCKS OF PRODUCE WHOLESALERS

By Joseph F. Herrick, Jr., agricultural economist
Stanley W. Burt, industrial specialist
Marvin R. Kercho, industrial specialist, and
Anthony Zagarella, industrial engineer
Marketing and Facilities Research Branch 1/

INTRODUCTION

On a per-ton basis, loading out delivery trucks is one of the most costly handling operations performed by service wholesalers of fresh fruits and vegetables. 2/

As used in this report, the term "loading out" refers to the cycle of operations performed in: (1) Removing produce from storage (either permanent or temporary storage), (2) transporting the produce from the storage point to an area near the tail gate of the delivery truck, and (3) loading the produce onto the truck. The first two of these operations, together with the splitting of packages, are, in the aggregate, known as "assembling" produce. Although the three operations in the cycle are usually performed in sequence, in the majority of the methods studied, assembly operations are separated from the truck-loading operation by the temporary storage of produce at the tail gate of the truck. 3/

Since the various methods of loading out delivery trucks require specialized office procedures, these procedures are outlined in the descriptions of the methods; however, the time of office workers has not been included in the comparisons of labor requirements.

Because some of the methods included were studied in multistory warehouses and others in single-floor buildings, data taken in multistory buildings were adjusted to a one-floor operation. That is, the time required for moving produce from the basement to the first floor and from the second floor to the first floor was subtracted. Distances from permanent or temporary storage to the area near the tail gate of the delivery truck were adjusted within a range of from 75 to 95 feet. This range is believed to be narrow enough to have no significant effect on the data.

1/ Marvin R. Kercho and Anthony Zagarella are former employees of the Marketing and Facilities Research Branch.

2/ The term "service wholesalers" as used in this report, refers to dealers who obtain orders through field salesmen or over the telephone and make deliveries to their customers.

3/ In some warehousing operations, temporary storage that eliminates or breaks the interdependence of operations in a cycle is referred to as a "temporary block."

In their efforts to reduce costs and minimize damage to produce, a number of service wholesalers have installed belt conveyors for use in loading delivery trucks. Others have developed improved methods for using equipment already owned.

One of the more important considerations in loading out delivery trucks is that they must be loaded with regard to the order in which the deliveries are to be made to customers along the route. That is, merchandise must be loaded onto the motortruck in inverse order to delivery, and should be placed so that the driver can unload the necessary items at each stop along his route with a minimum amount of rehandling. Thought should also be given to stowing items so that heavier and sturdier packages, such as potatoes, lettuce, and boxed apples, will be placed at the bottom of the load, and lighter, more easily damaged items, such as tomatoes, mushrooms, and strawberries, placed on top. To minimize in-transit damage and keep the center of gravity low, packages should be placed so that the load will not shift en route. ^{4/} When the center of gravity is low, the load rides better than "high-center" loads.

The service wholesaler must perform loading-out operations expeditiously and accurately since the very nature of his business requires that orders be delivered in good condition and that they be accurately and completely filled. Customer satisfaction is a prime requisite in operating a successful and profitable service wholesale business.

This report describes and appraises six methods currently used by produce wholesalers in loading out delivery trucks. These methods involve the use of belt conveyors and other types of equipment for loading the motortruck and several types or combinations of types of equipment for assembling the produce.

Studies of materials-handling operations in the stores and warehouses of wholesale fruit and vegetable distributors are still under way and it is expected that a more comprehensive report covering a greater variety of methods, equipment, and operations will be published later.

^{4/} Several excellent illustrations of good and bad loading patterns are presented in Service Wholesalers Division Bulletin No. 95, published by United Fresh Fruit and Vegetable Association, Oct. 20, 1951. 4 pp., illus.

- 3 -

SOME METHODS USED TO LOAD OUT DELIVERY TRUCKS OF PRODUCE WHOLESALERS

A number of wholesale produce stores and warehouses were visited for the purpose of analyzing and studying the various operations performed in handling produce. One of the operations studied was the loading out of delivery trucks. A number of methods in which a wide variety of types and combinations of types of produce-handling equipment was used in performing the necessary handling, were time-studied.

This chapter describes the more commonly used methods of loading out that employ 11 different types of materials-handling equipment either singly or in combination. These methods and the manner in which the equipment was used are outlined in subsequent paragraphs. Some features of these six methods are alike; hence, some repetition is unavoidable in giving a clear picture of each method.

Méthod A - Use of Low-Lift Platform Trucks, Dead Skids, and Belt Conveyors 5/

When this method is used, dead skids transported with low-lift hand platform trucks, both manual and power-driven, and an industrial low-lift platform truck are used to perform assembly operations, and belt conveyors are used to perform the motortruck loading operation. This method was studied in a relatively wide and shallow depth warehouse. The warehouse was single-storied and did not have a platform at the loading points; however, the floor was at truck-bed height. Access to the motortrucks for loading was through doors in the outer wall of the building. Figure 1 shows the general layout of the physical facilities in which this method was studied and the location and use of the equipment.

Description of Method

The necessary working papers for loading-out operations are prepared in the office in accordance with the following procedure. At the end of each day's run the driver-salesmen (or salesmen) make up, by items or products, a recapitulation or summary ("recap" is the term used by the trade) of all orders or invoices for the customers on his route. This recap is telephoned to the office. Office workers record the recap in duplicate as the items are

5/ The low-lift platform truck is a load-carrying piece of materials-handling equipment capable of lifting, transporting, and positioning loaded or empty skids. This truck can be an industrial type (ride-on) or hand type (walkie); the industrial type is power driven while the hand type is either manual or power driven. A dead skid is a flat-top platform equipped with legs for handling with platform lift truck equipment. A belt conveyor is a conveyor equipped with a power-driven endless belt operating in a straight line over end pulleys and on roller or flat beds. Loads are placed on the top strand of the belt and move in the direction of the top strand.

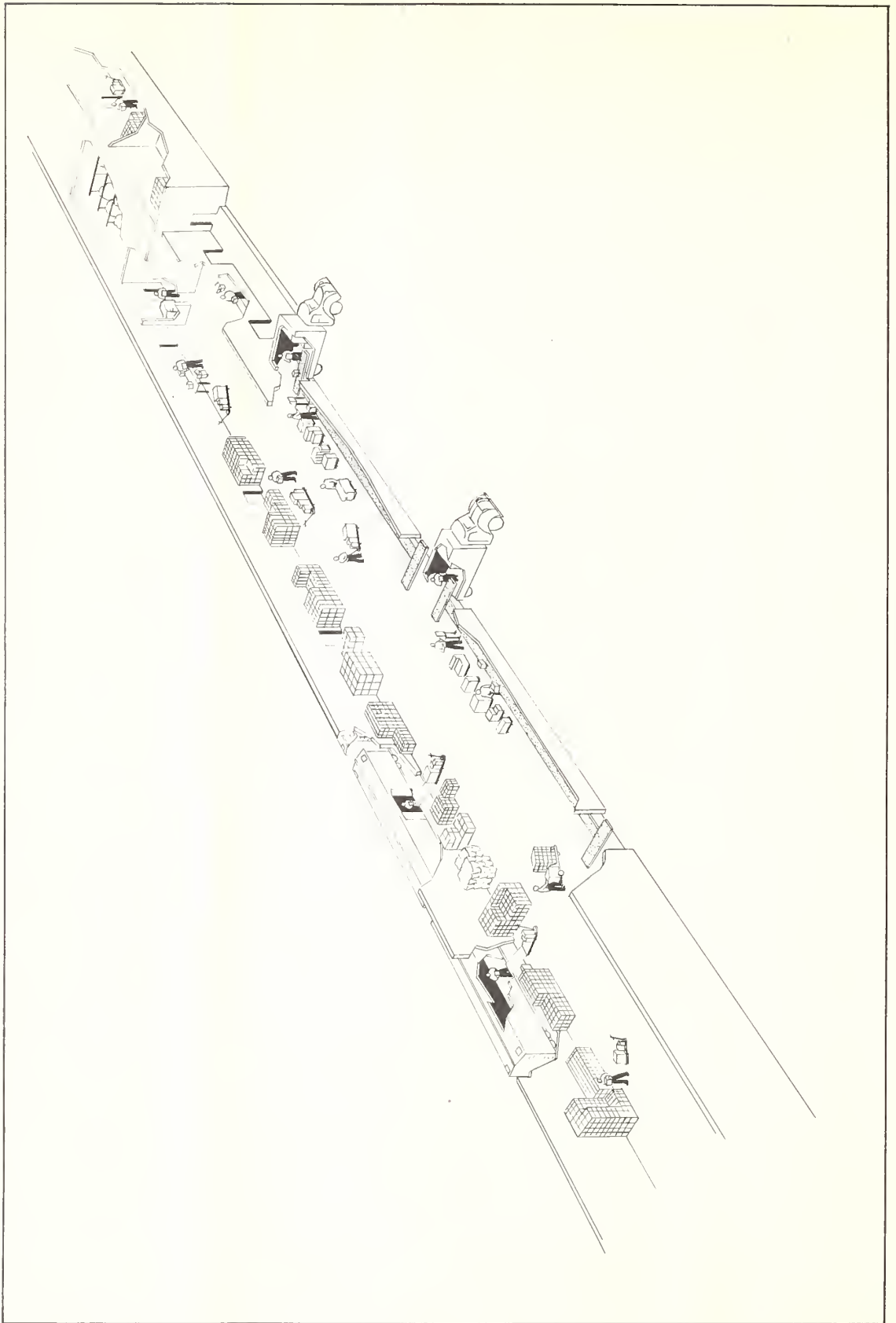


Figure 1.--Layout of a warehouse in which dead skids and low-lift platform trucks are used for performing assembly operations and belt conveyors to perform motortruck loading operations.

called in to them. Tonnage is then computed for each load or route, and a master recap of all loads or sales is made for the use of the management and the purchasing department. Local driver-salesmen bring their invoices to the office in person on arrival at the warehouse. Out-of-city salesmen forward their invoices to the office by first available transportation. In the office the invoices are checked against the recaps made from the earlier telephone call and the price extensions and totals on the invoices are checked. A list of items for which packages are to be "split" to fill small orders is also made up from the invoices. 6/ A copy of the recap for each truckload or route is then sent to the warehouse floor, where it is torn along perforations that divide the recapped items by departments. This division of the recap permits individual members of the assembly crew to assemble merchandise independently, without interference with other workers, and eliminates the possibilities of duplicating items. The lists of split items for each load are forwarded to the workers making up the split packages.

Assembling.-- With this method the assembly operations involve: (1) Picking or removing from storage the exact types, amounts, and sizes of produce required for each load or route and splitting packages; and (2) moving the full and split packages to the proper assembly point for loading. The assembly crew works completely independently of the loading crew but completes its job for each route before the loading operation begins.

Dead skids provide the medium for picking from stock the items needed for the order. Manual or electric motorized low-lift hand platform trucks and an industrial low-lift platform truck are used to transport both loaded and empty skids between storage and assembly points. Small four-wheel hand trucks are used for the split items. Each assembly man receives a part of the recap, covering a number of items that he is expected to fill for a specific truckload. From the storage points within the warehouse and from other hold points, such as refrigerated railroad cars, the individual assemblyman removes from the stack the correct amount of each item needed and loads the packages on the skid. He proceeds from point to point within the warehouse until he has either filled the skid or has obtained all the items needed for that load. As each skid is loaded it is moved and deposited, with the load intact, alongside the belt conveyor, in the assembly area designated for that particular truckload, where an empty skid is picked up and the cycle of assembly operations is repeated until the worker's portion of the recap has been completely filled.

The assembly crew for each loading area consists of four workers, not including workers splitting packages. This size of crew is normally able to remain just ahead of the loading crew assigned to that area. Two men spend

6/ A number of service wholesalers of fruits and vegetables sell certain items to small dealers in quantities less than the original package; this is known as "splitting" or "split package sale."

full time making up split items--one works on wet produce, the other on dry produce. Each man makes up the wet- or dry-split items for each motortruck to be loaded, places them on a four-wheel hand truck, and transports them to the appropriate point for loading.

When assembly operations for the entire truckload have been completed they are repeated for the next truckload at another assembly area. Each assembled truckload is checked by a worker other than the assemblymen to assure accuracy and completeness. This man is responsible for each load and double checks it before it is placed on the motortruck.

Loading.--The truck-loading operation may begin at any time after all produce for the load has been assembled. The assembly area forms a temporary block, which eliminates the interdependence of the operations in the cycle.

Cantilever-type belt conveyors are used to move the merchandise from the assembly area into the motortruck. The main conveyor line extends directly into the body of the motortruck and connects laterally with other belt conveyors from which it is fed. (See fig. 1.) Each set of lateral conveyors is about 90 feet long and each of the cantilever conveyors is 14 feet long, and has a 36-inch section of roller conveyor affixed to the unloading end.

Conveyor lines are set up so that by reversing the direction of the belt, each set of lateral conveyors can feed, alternately, two cantilever belt conveyors that carry directly into the motortruck. That is, one set of lateral conveyors takes care of two loading stations. At least two such stations are necessary to obtain maximum efficiency with this method.

A crew consisting of three workers is used to load each motortruck, and these workers are assigned as follows: One checker who calls the items in proper sequence; one loader who places items on the conveyor system as they are called by the checker; and one truckman who works inside the motortruck removing packages from the truck end of the conveyor system and stowing them.

After the cantilever conveyor has been positioned, the checker, using the invoices, which are arranged in the reverse order of delivery, calls one, two, or three items at a time, according to the quantity of each item. As the items are called, the loader picks up the items from the assembly area and places them on the lateral belt conveyor. The truckman removes the packages from the end of the cantilever conveyor and stows them properly. The checker occasionally helps place merchandise on the conveyor when the items are convenient to the checking stand. This routine is followed until all orders are loaded.

During the loading operation, one end of the conveyor is kept as close as the working space permits to the stowage point inside the motor-truck. As loading progresses, it is necessary to stop loading and move the conveyor part way out of the truck to make room for more produce. This is done about three or four times for each load.

If, after the items on the last invoice are called, there is still produce in the assembly area, the checker reviews the invoices to locate possible errors. Since only the items called for that truckload are placed in the assembly area, the load will not check out until all the items are on the truck. After it has been determined that the load is in order, the conveyor is removed and the truck closed.

Comments on Method

On the basis of time studies, the results obtained with this method compare favorably with some other methods thus far studied. Productivity of labor with this method is about average.

One of the defects of this method, which is also applicable to all other methods studied, except Method F, is that as the checker leafs through the invoices there is a tendency to skip about from one to another to consolidate items. This results in a number of delays. 7/ Such delays are transmitted throughout the loading operation and result in lost time on the part of all three crew members.

With this method the different operations in the cycle are performed separately or independently of each other. Merchandise can be assembled for one truck simultaneously with the loading of another truck, which minimizes the time lost by one crew while it waits on another crew to complete its assignment. Such specialization permits a greater volume of merchandise to be handled within a given time within the same facility.

Method B - Use of Two-Wheel Hand Trucks, Semilive Skids and Jacks, and Belt Conveyors 8/

Two-wheel hand trucks and semilive skids and jacks are used to perform assembly operations. Belt conveyors are used to load the delivery trucks.

7/ A method of using recording and transcribing equipment, reported in Agricultural Information Bulletin No. 43, U. S. Department of Agriculture, June 1951, eliminates these delays.

8/ The two-wheel hand truck is a lever-type truck equipped with two wheels. In loading this equipment the toe plate of the truck is placed under the load to be carried; then by pulling down on the truck's two handles the load is picked off the floor. The combination then can be manually pushed to a desired location. Semilive skids and jacks are used together. The semilive skid is a load-carrying platform with two rigid wheels at one end and two skid legs at the other. The semilive skid jack is a lever-type handle equipped with two wheels mounted on a rigid axle and a load-carrying device over the wheels for attachment to semilive skids. The jack is applied to the skid leg end in a near-vertical position and is then lowered approximately 30° for lifting and transporting the load.

The loading platform of the warehouse in which this method of loading out was studied is at truck-bed height. As a consequence, the loading of produce into delivery trucks requires no lowering or raising of the merchandise. The platform is relatively narrow and provides limited working space (fig. 2). It becomes congested when all the produce for a truckload is assembled.

All products except tomatoes are stored on the first floor of the warehouse. Tomatoes are stored, ripened, and repacked in the basement and are brought up to the main floor on the elevator, a skid load at a time. The effect of this interfloor movement has been eliminated in making comparisons of labor and equipment costs with other methods. Cooler rooms are so arranged that a number of products must be transported considerable distances to the assembly area. Tomatoes, bananas in 40-pound boxes, and some fruit are warehoused on semilive skids; all other items are hand stacked at the storage points and breaking out of storage by individual packages is necessary in assembly operations.

Description of Method

As salesmen bring in their invoices, the night clerk prepares recaps of individual loads so that the loading-out crew can begin assembling produce as soon as it reports for duty. Salesmen in more distant territories call in by telephone and dictate a recap of their orders to the clerk. Invoices covering individual orders on their routes are brought in later in the evening and are checked against the recaps by the clerks who then make the price extensions.

After the recap and invoices for a specific load are found to be in order, the clerk arranges the invoices in proper sequence, attaches them with the recap to a clip board, and delivers them to the loading-out crew for use in assembling and loading operations.

Assembling.--As in Method A, assembling by this method involves the removal from storage of the exact types, amounts, and sizes of produce needed for each load or route and the moving of this produce from the stacking point to the assembly area near the tail gate of the truck. However, when this method is used assembling is not a continuous operation. After the produce for each truckload has been assembled, four of the six workers previously assigned to assembly operations begin loading the motortruck.

No specified pattern was used for depositing the various products in the assembly area. Each load was placed wherever space was available, which resulted in congestion in that area.

Produce is assembled primarily on two-wheel hand trucks. Semilive skids, which are activated with jacks, are used for about 15 percent of this volume (tomatoes, bananas in 40-pound boxes, and a little fruit.)

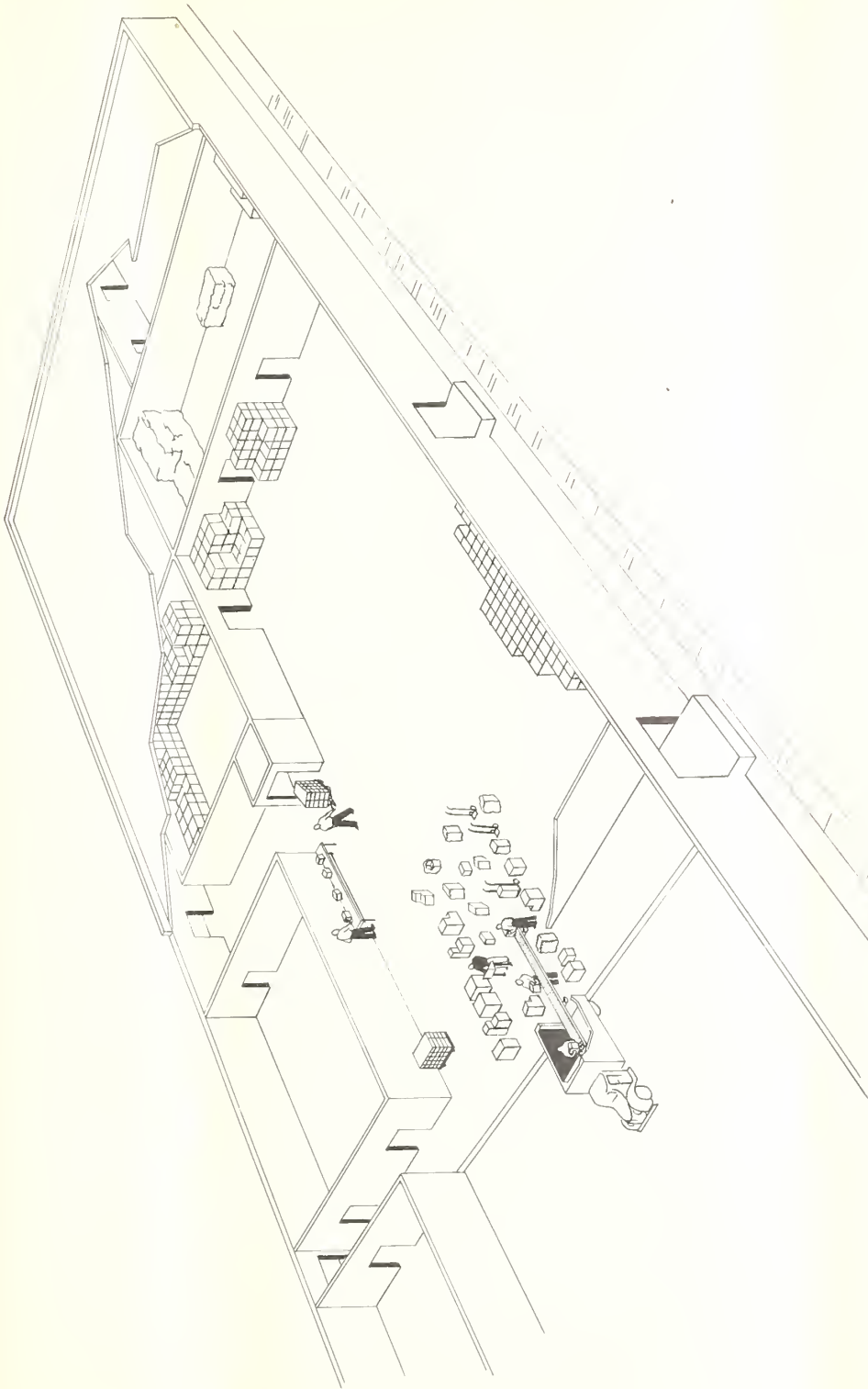


Figure 2.--Layout of a warehouse in which two-wheel hand trucks and semilive skids and jacks are used for performing assembly operations and a single belt conveyor for performing the motortruck loading operation.

Hand trucks are loaded a package at a time from conventional stacks at the storage points and are usually off-loaded, except when used for potatoes. Skid loads are handled as units until packages are removed for loading onto the motortruck. Because of congestion on the loading platform the maneuvering of equipment is difficult.

Assembly operations begin when the foreman, who is also the checker during loading and who assists in assembling the produce items between truckloads, assigns to each of the other five members of the loading-out crew selected items from the recap to pick from stock and move to the assembly area. The checker (foreman) and three workers shift to loading the truck after assembly is complete for a given truck. The fifth worker of the crew works full time assembling and switching motortrucks. The trucks are switched usually while assembly operation is under way. The sixth worker in the crew is assigned the exclusive duty of splitting packages and is assisted from time to time by other workers between loading operations.

Using two-wheel hand trucks and semilive skids and jacks the workers remove the specified items from various storage areas, load their equipment, and return to the assembly area. Hand trucks are unloaded and skids deposited, with the load intact, as near as possible to the tail gate of the motortruck to be loaded. This cycle is repeated until all items are assembled for a specific load or route.

During the assembly of each load the checker spends some time performing the clerical work associated with that load, but most of his time is devoted to assembling items with the other workers.

Loading.--A portable, horizontal, 30-foot belt conveyor is the only item of equipment used to load the motortrucks. This conveyor is on casters, and during loading operations the end of the conveyor, which is pushed into the motortruck body, can be kept near the working face of the load. After a motortruck is loaded, the belt conveyor is removed and pushed into the next motortruck to be loaded.

After all items for a particular load are assembled, four workers leave the assembly operation to load the motortruck and are assigned as follows: (1) The checker takes the invoices for the load; (2) the truckman enters the motortruck and makes ready to receive items as they are moved into the truck on the conveyor; and (3) two loaders are stationed one on each side of the conveyor so that items can be located and placed on the conveyor as they are called by the checker. Invoices are arranged in inverse order of delivery, so that the last order to be delivered is placed at the front of the truck bed.

After the workers reach their respective stations and the conveyor section is in proper position, the checker starts calling off the items from the invoices. As he calls the items, the two loaders locate and place these items on the conveyor. As the items move by him en route

to the motortruck, the checker glances at them to see that they are the items called. The truckman removes the packages from the conveyor and stows them.

If the packages enter the motortruck faster than the truckman can remove and stow them, he calls to the floor and the conveyor belt is stopped. As in Method A, the end of the conveyor is kept as close to the stowage point inside the motortruck as working space permits. Upon completing the load and determining that it is in order, the conveyor is removed and the truck door closed. The loading crew then returns to assembly operations for the next load.

Comments on Method

In comparison with skids and four-wheel hand platform trucks, two-wheel hand trucks can move only a relatively small load per trip. This fact means that a somewhat larger amount of labor is required to assemble produce by use of this method than would be required with the use of skids or four-wheel hand trucks under similar conditions.

The use of only one section of belt conveyor precludes the use of an assembly-line method of loading. The use of only one section of conveyor limits the area in which the packages can be assembled and therefore leads to crowded working conditions. The placing of the merchandise on the conveyor belt facilitates checking the items being loaded into the motortruck. In addition, the truckman can see well in advance what items are moving in for stowing and is better able to arrange the load properly for transit.

Method C - Use of Semilive Skids and Jacks and Elevating and Horizontal Belt Conveyors 9/

The types of equipment used in this method are basically the same as those used in some of the other methods described, but with these differences: (1) Semilive skids and jacks are used almost exclusively to assemble produce, and (2) a 10-foot elevating belt conveyor in combination with a horizontal belt conveyor is used to load the motortruck.

The warehouse at which this method was studied has no loading platforms, and the warehouse floor is at ground level (fig. 3). All produce is assembled on the warehouse floor and must be raised from the floor level to truck-bed level--a height of about 45 inches--in loading the motortruck. This arrangement presents problems not encountered at facilities with platforms at truck-bed level.

9/ The elevating belt conveyor is a power-driven belt conveyor used to raise loads to a higher level.

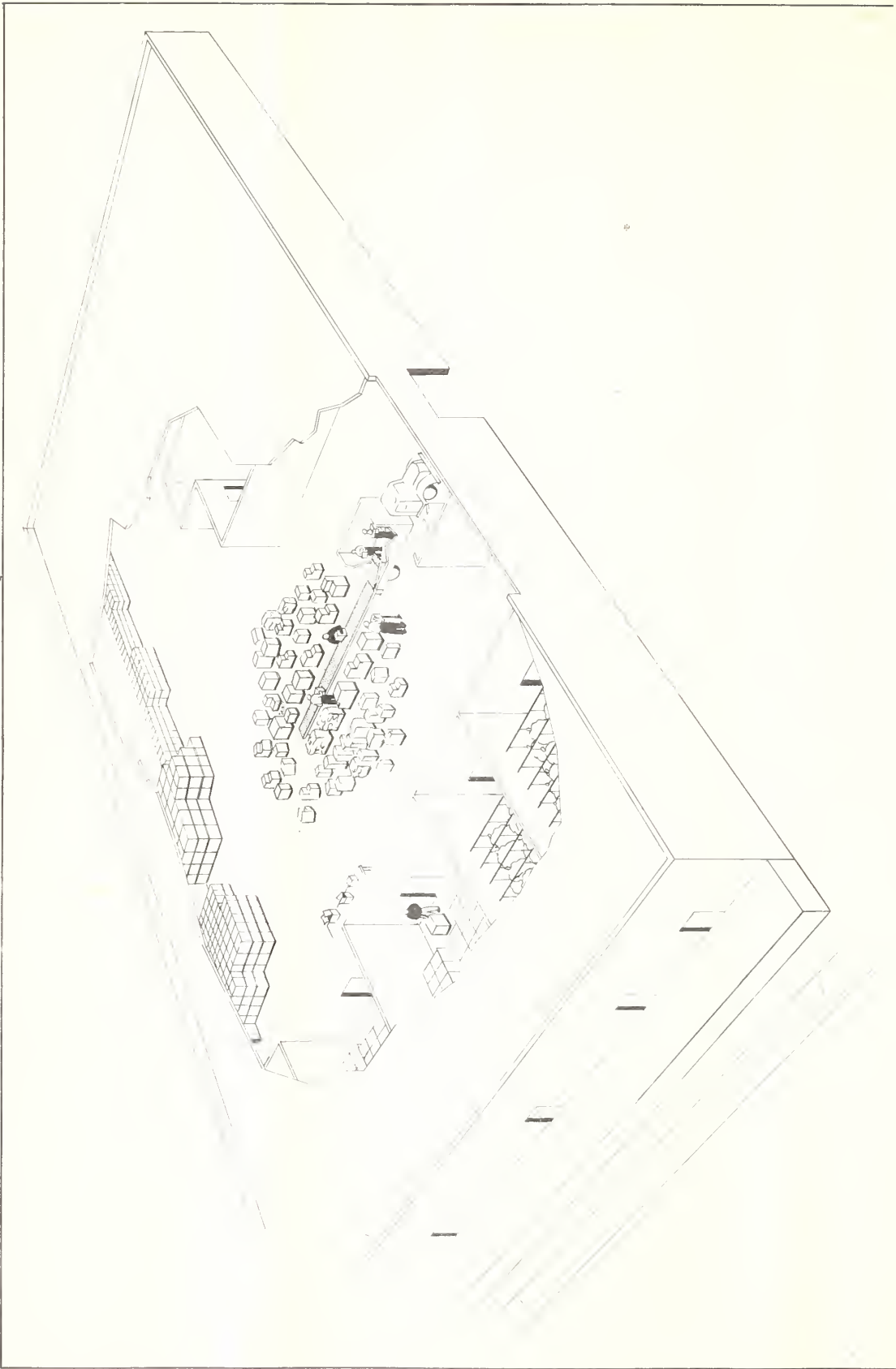


Figure 3.--Layout of a warehouse without loading platforms and with the floor at ground level in which semilive skids and jacks are used for performing assembly operations and a combination of horizontal and elevating belt conveyors are used for loading the motortruck.

Description of Method

The salesmen call or bring to the office the invoices for their routes. From these invoices the night clerk prepares recaps by routes. These recaps are used for assembling produce preparatory to loading the motortruck.

Assembling.--After receiving the portion of the recap for which he is assigned responsibility, each worker in the assembly crew removes the required items from the stacks or storage points, loads these onto the skids, and transports the skid loads to the assembly area.

Although the semilive skid and jack is the principal type of handling equipment used to assemble produce, two-wheel hand trucks are used occasionally to assemble small lots. The warehouse in which this method was studied used 36- by 72-inch skids.

The loading-out crew consists of six workers: One checker, who is also the foreman, and five men who perform the actual assembling and truck-loading operations. After checking the recap and determining the items each is to assemble, five workers move empty semilive skids and jacks (occasionally two-wheel hand trucks are used) to the various storage areas, where the kinds and amounts of each product listed on the recap (other than staple items) is removed from the stack and loaded onto the skid, and, when the skid is loaded, transported to the assembly area. The loaded skid is positioned in whatever space is available, with the load intact, then the worker removes the skid jack, picks up an empty skid, checks the recap, and repeats the cycle until a specific truckload has been assembled. This method employs the "assembly-line system" to the extent that, initially staple items, such as potatoes, cabbage, and lettuce are moved to the assembly area in skid-load lots (unit loads) without regard to the number of packages of the product required for the first motortruck load. In loading, packages are removed from the skids as needed. As the supply of produce on these skids is exhausted, additional skid or unit loads are moved in. In other words, staple items are not assembled in the exact amounts required for filling the orders to be loaded onto each delivery truck. After all delivery trucks are loaded, all unneeded produce is returned to storage.

One of the six crew members, whose duty is the splitting of packages, continues his work on assembly operations throughout the truck-loading operation.

Loading.--The method and equipment used for loading motortrucks differ from the methods previously discussed because the warehouse lacks a loading platform and the floor is at ground or curb level, which makes necessary the use of a type of equipment capable of transporting and elevating packages from ground level to truck-bed level.

To load motortrucks, a 30-foot "horizontal" belt conveyor is connected with one end of a 10-foot elevating-type belt conveyor. To the end of the elevating conveyor, which projects into the motortruck, a 3-foot length of roller conveyor is attached so that as items are carried off the end of the belt conveyor they move onto the gravity roller conveyor. A stop is provided at the end of the roller conveyor, so that this section of the conveyor serves as a holding point until the truckman can remove the items.

Upon completion of assembly operations for each motortruck load, five of the six crew members are stationed as follows to begin the truck-loading operation: Two along opposite sides of the conveyor; two in the delivery truck; and one, the checker-foreman, at checking stand, where he arranges the invoices in proper sequence for calling the items.

As the checker calls items from the invoices, the two floor men alongside the conveyor locate these items and place them on the conveyor. These items are moved by the horizontal belt conveyor onto the elevating belt conveyor (see fig. 3). The conveyor raises the items to a point just inside the motortruck, where they are removed by the two truckmen and stowed. As each item reaches the top of the elevating belt conveyor, the package rolls onto the attached roller conveyor, where it remains until moved.

Two truckmen are necessary because of the impossibility in a warehouse with the floor at curb level of extending a horizontal conveyor into the motortruck. As a result each item must be carried manually from the end of the elevating conveyor at the tail gate to its stowage point in the motortruck.

When all orders have been loaded, the motortruck is closed, driven to the parking area, and an empty truck brought in. Following completion of the loading operation the five workers begin assembling the next truckload.

Comments on Method

For a warehouse with the floor at ground or curb height and having no loading platform, the method of loading previously described is relatively efficient, since the moving of merchandise from the ground level up to the motortruck-bed level presents a problem in this type of installation. This problem may be eliminated by using the 10-foot section elevating belt conveyor. This conveyor also simplifies the checking of items and makes it easier to arrange the produce in the motortruck, because the truckmen can see before their arrival what items are moving up the conveyors for stowing.

Since only one 30-foot section of horizontal belt conveyor was used in connection with the elevating conveyor, the complete assembly-line system of loading was not possible.

The use of semilive skids and jacks for assembling produce permits the utilization of the unit-load principle. Time studies show that labor required for performing assembly operations compares favorably with other methods, in spite of the handicaps of facility layout and design.

The use of at least one additional 30-foot horizontal belt conveyor section should increase the efficiency of this method.

Method D - Use of Fork-Lift Trucks and Pallets, and
Belt Conveyors 10/

This method involves the use of a fairly complete assembly-line system, which is set up in the assembly area adjacent to the belt conveyors used for loading delivery trucks. The majority of produce items are stored in unit loads on pallets, usually two pallets high. Entire unit loads are withdrawn from storage and transported to the assembly area by a fork-lift truck. The entire assembly line is initially stocked with items in unit loads, and thereafter the only assembly operations performed are those required to replenish the supply of items needed. Only a few minor items are moved to the assembly area in other than pallet loads. Except for these minor items, this method does not require stock picking for each motortruck load, an operation that would be necessary with some other methods previously described. It should be pointed out that where large numbers of items must be stocked in the assembly line, this method has its limitations.

As indicated in figure 4, the facilities in which this method was studied are of modern design and are conducive to efficient loading-out operations. Floors and platforms are at truck-bed height so that a section of cantilever-type belt conveyor can be extended directly from the platform into the motortruck. Since the conveyor moves the produce directly to the stowing point in the motortruck, one truckman can easily remove the items from the conveyor and stow them.

Description of Method

In the office, orders or invoices for merchandise to be loaded on each truck are assembled in the order of sequence that the deliveries to individual customers are to be made. Although recaps are made for other uses,

10/ The fork-lift truck is a cantilever-type truck which carries its load on two forks extended in front of the vehicle. It is used for picking up, transporting, and stacking (or setting down in specific locations) loaded pallets. The fork-lift truck can be powered by gasoline or electricity. Pallets are load-carrying platforms, usually with upper and lower decks separated by stringers, capable of being handled by fork-lift trucks.

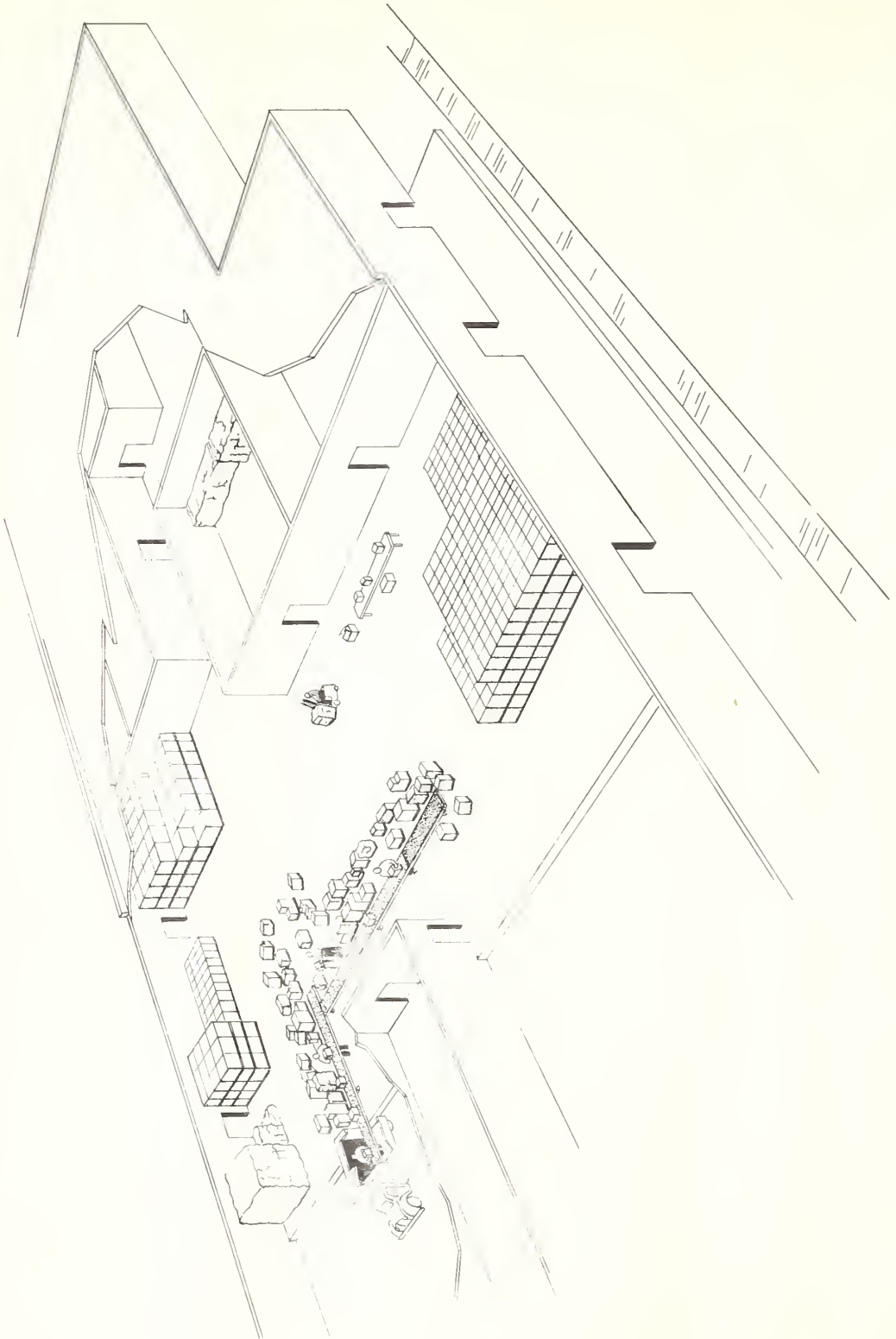


Figure 4.--Layout of a warehouse in which the assembly line method of loading out with belt conveyors is used and fork-lift trucks and pallets are used for assembly operations.

they are not needed with the assembly-line system in loading-out operations except to give an indication of tonnage to be handled, which is, of course, an important factor in properly loading motortrucks.

Assembling.--The assembly operation consists of removing complete pallet loads from storage, transporting the unit load to the assembly area, and depositing it alongside the conveyors, without regard to any particular motor-truck load. An electric-powered industrial fork-lift truck and, occasionally, an electric walkie low-lift pallet truck were used for handling pallet loads. Semilive skids and jacks, which also permit the use of the unit-load principle, were employed for bananas in 40-pound boxes and some other items were packed in consumer-size packages.

Before motortruck-loading operations begin, the assembly line at the conveyor is completely stocked. With the exception of a few specialty items, merchandise is assembled on pallets and semilive skids. Items in unit or pallet loads are not removed or off-loaded until the individual packages are placed on the conveyor belt during the loading of the motortruck.

In performing this initial stocking of the assembly line, the entire loading-out crew of five members work on assembly operations; however, when this is completed, four men shift to loading. The fifth man continues to perform assembly jobs, dividing his time about equally between package splitting and bringing up additional pallet and skid loads to the line as needed to replenish the supply of a specific item.

Partially used pallet loads are returned to storage on completion of loading operations for the night.

Loading.--The loading operation consists of calling the items one by one, in the desired sequence, from the invoices, placing the packages on the conveyors, removing them from the conveyor in the motortruck, and properly stowing them.

In the assembly and loading area the conveyors are arranged in the following manner: One 30-foot cantilever belt conveyor extends into the motortruck from the warehouse and two 30-foot conveyor sections, joined end-to-end, connect at right angles to, and feed onto, the cantilever conveyor. The equipment in this arrangement forms a "T" on the warehouse floor and carries the merchandise directly to the stowage point in the motortruck (fig. 4). As with the other methods, a short piece of roller conveyor is attached to the truck end of the belt conveyor to keep the produce from toppling off to the floor.

After the assembly line has been set up and the motortruck to be loaded has been positioned, a crew, consisting of four members, begins the loading operation. Crew members are: A checker who is responsible for calling the items in the proper loading sequence (the last delivery is called first and the first last) and for seeing that the items checked off are actually loaded; two floormen who are located alongside and place the packages on

the belt conveyor as items are called by the checker, and one truckman who works inside the motortruck, removing packages from the conveyor and stowing the merchandise. Occasionally, when loading work is exceptionally heavy, the size of the loading crew is increased to five members. The additional worker assists on the truck during the loading operation, since that point may become the bottleneck in the operation.

After each motortruck has been loaded, two of the four men who loaded the truck quickly check the stock in the line and help restock any items that appear to be short; the checker performs some clerical work associated with the next load; and the fourth man moves out the loaded truck and replaces it with an empty. As soon as the truck is in position, the four members of the loading crew return to their loading assignments.

Comments on Method

The assembly-line method of loading out permits the full utilization of the unit-load principle, thus bringing about savings in the assembly operations, which usually require the most of the labor used in loading out. An appreciable reduction in man-hours of labor is made possible because full pallet and skid loads of merchandise are taken from the storage points and brought to the assembly area and deposited intact. Methods involving the handling of each item from storage onto the handling equipment and rehandling each item off the equipment onto the floor are costly when compared with the handling of full pallet or skid loads.

The electric fork-lift truck maximizes the use of space where products are stored on pallets and makes the stocking of the assembly line throughout the night a comparatively simple operation.

However, the use of this method requires a relatively large investment in equipment. For example, belt conveyors for this method currently cost approximately \$1,500 each and the 2,000-pound capacity electric fork-lift truck approximately \$6,000. Equipment costs vary according to the shipping distance from factory. Whether the savings will justify the initial investment depends upon the volume of merchandise handled and the adaptability of the equipment to the facility. In considering such an investment, the individual service wholesaler should keep in mind the possibilities of using the equipment for performing other materials-handling operations, such as receiving produce.

Method E - Use of Four-Wheel Hand Trucks, Fork-Lift
Truck and Pallets, Gravity Conveyor, and
Manual Handling 11/

Four-wheel hand platform trucks and a fork-lift truck are used for performing assembly operations. Palletized items are handled with the fork-lift truck. The truck-loading operation is performed either manually or by use of a section of gravity conveyor.

The warehouse in which this method was studied is a modern one-floor structure designed and built for receiving, storing, and loading out fresh fruits and vegetables (fig. 5). The platform is of truck-bed height, coolers are large and accessible, and aisles are wide. The platform is 22 feet deep and is used to a limited degree for storage. Package-splitting operations are performed at a bench on the platform.

Description of Method

Orders telephoned in during the afternoon by out-of-town salesmen are recorded. A clerk monitors the call so that the recording machine can be stopped when each call has been completed. The recording is then played back and invoices typed from it. Three copies are made--one each for the buyer, driver, and checker. A recap of the invoices for each truckload is prepared by the foreman of the night crew, who also arranges the invoices in proper sequence for loading. For use in performing assembly operations, the recap is divided into five parts: (1) Vegetables, (2) fruits, (3) split packages, (4) miscellaneous, and (5) "short" items (items not in stock at time assembly operations began but which were to be loaded later if received prior to the departure of the delivery truck).

Assembling.--Under this method six workers participate alternately in assembling produce for each motortruck load and in loading the truck. That is, the crew works as a unit in assembling or in loading. The foreman devotes nearly all his time to performing clerical work and spends only a small amount of time on the floor.

White potatoes and bananas in 40-pound boxes are moved from the storage areas to the assembly area on pallets with a fork-lift truck. These two items represent about 40 percent of the tonnage of each motortruck load. All other produce items, with a few minor exceptions, also were stored on pallets; however, they were assembled on four-wheel hand trucks.

When ready to begin assembly, the six floormen enter the office, and parts of the recap are divided among the men.

11/ The four-wheel hand truck is a load-carrying platform equipped with two rigid wheels on one end and two swivel casters on the other; it is moved about manually. The gravity conveyor is made of two parallel rails between which are mounted a series of rollers or wheels whose axles are perpendicular to the rails; it is nonpowered. Manual handling is the picking up, moving, and setting down of items without the aid of any equipment.

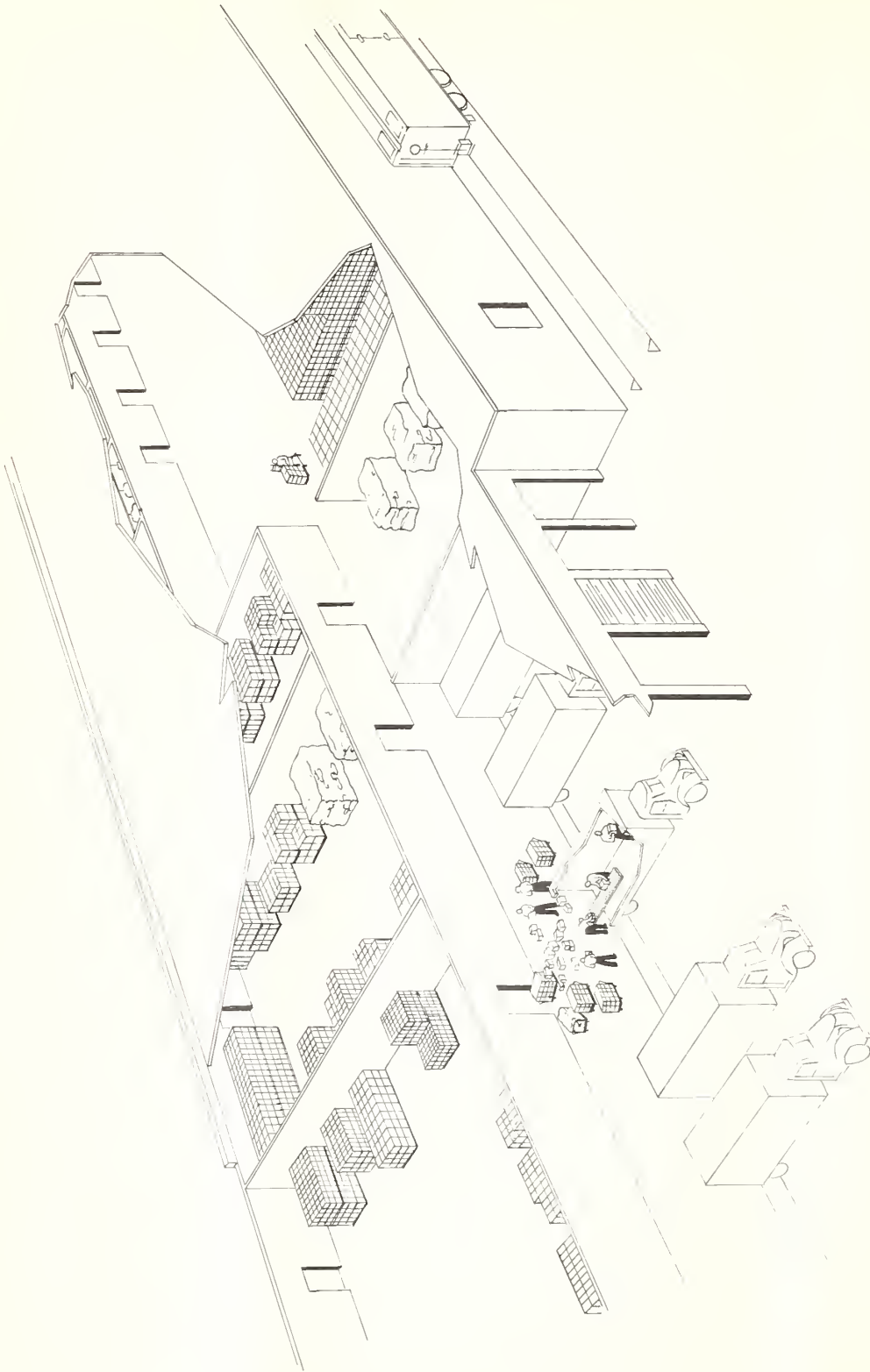


Figure 5.--Layout of a warehouse in which four-wheel hand trucks and fork-lift truck and pallets are used in performing assembly operations and gravity conveyor and manual handling in loading the motortruck.

The assembly crew consists of six members, other than the foreman: Two package splitters, three hand truckers, and one fork-lift operator. Of the two workers assigned to split package items, one worker breaks packages and the other worker weighs them, for the full assembly period. The three hand truckers are **responsible** for assembling all vegetables, fruits, and miscellaneous items in stock other than white potatoes and bananas, but when the recap calls for a full load of some other items stored on pallets the fork-lift truck operator moves the entire pallet or unit load to the assembly area. Hand truckers pick items from the recap from the various storage points, push the loaded hand trucks to and position them in the assembly area near the tail gate of the delivery truck, and pick up an empty hand truck and return it to the storage areas to repeat the cycle. Neither the four-wheel hand trucks nor the pallets are off-loaded until truck loading begins. That is, the unit loads remain intact in the assembly area. All white potatoes and bananas are assembled in unit loads on pallets with a fork-lift truck.

Although the loading platform is very deep, the assembly area becomes congested as assembly progresses. The accumulation of hand trucks slows up traffic considerably. As each crew member completes the assembly of his respective parts of the recap, he waits in the assembly area until the last member is through, for the loading of the motortruck.

Loading.--Although the facility is well-adapted to an efficient truck-loading operation, this method does not utilize the inherent advantages of the facility and illustrates the use of a poorly organized method in a new facility.

Except for the use of a 10-foot section of gravity wheel conveyor, which is more often a hindrance than an aid, the loading of motortrucks is accomplished by means of manual handling.

The members of the six-man crew are used in loading operations as follows: One checker, positioned near the tail gate of the motortruck, who calls off from the invoices for the load the items that are to be loaded onto the motortruck; two truckmen, inside the motortruck, who receive packages from the men on the platform and stow them so as to minimize damage in transit and make the packages accessible to the driver at the delivery point; three floormen, on the platform, who locate the items called by the checker and either manually or with the conveyor move these packages to the truckmen.

All bananas are loaded first, the boxes being stowed along the right side of the motortruck, following which the checker calls other items and the quantities of each from an invoice. As these items are called, the three floormen search for the items and as they are found the packages are lifted and, if they are in a rigid container, they are placed on the wheel conveyor which extends from the platform into the motortruck. Each floorman calls back the description and quantity of each item he handles so the checker may have the assurance that each order is properly filled.

Bagged items and other items in containers that do not roll properly on a gravity wheel conveyor are handed over the conveyor to the truckmen. This type of handling was necessary for about 40 percent of the volume of each truckload. In loading items of this type the conveyor was very much in the way.

After receiving each package from a floorman or picking it up from the conveyor, the truckmen carry the package to its proper position in the truck and stow it.

After each motortruck has been loaded, the conveyor is withdrawn, the tail gate closed, and the truck withdrawn from the platform. The six crew members are then ready to assemble the next load.

Comments on Method

This method has two major defects: (1) Too many workers are used in each operation, and (2) the wheel conveyor used in loading motortrucks adds little, if anything, to the efficiency of the operation.

Six men assembling produce simultaneously create confusion and cause congestion. Each worker has only a relatively few number of items to assemble, but each has a four-wheel hand truck on which to assemble them, which places an excessively large number of items of handling equipment in the traffic lanes.

With this method the amount of unproductive time is large because, as each assembler completes his part of the operation, he stands by idle until the sixth, or last, assembler has completed his assignment. With every load assembled for loading there is a period when five men are idle while waiting for the sixth worker to complete his task.

The truck-loading operation is also overmanned--too many men are attempting to work in too small an area. Moreover, delays on the part of one worker could be transmitted throughout the operation, thus resulting in idleness on the part of the other five workers.

The 10-foot gravity wheel conveyor rested on the truck bed at one end, and was raised slightly above the platform level at the other end. The excessive amount of bending over and lifting that resulted from this conveyor arrangement induced a high fatigue factor with no compensatory increase in the rate of loading.

Method F - Use of Four-Wheel Hand Trucks

This method involves the use of four-wheel hand trucks alone for performing both the assembly of produce and the loading of motortrucks. The method is flexible and eliminates some of the extra handlings associated

with other equipment combinations. Moreover, less space is required in the assembly area than with the methods previously described. Although the warehouse in which this method was studied is not of recent construction, the loading platform is of approximate truck-bed height--an important consideration in making the method practicable and workable. The warehouse is a multistory structure served by one rather slow-moving elevator. At the time the method was time-studied, the basement and the first and second floors were being utilized. ^{12/} The layout of the warehouse and the use of equipment are shown in figure 6.

Description of Method

The night office force consists of a full-time clerk and a part-time assistant. Local salesmen turn over their order slips to the full-time clerk. Salesmen serving remote communities, or who for some reason cannot bring their order slips to the office, telephone their orders. From the order slips invoices are prepared--one copy for the store to which delivery is made, one for the truck driver (this copy after being signed as a receipt by the customer placing the order, is returned to the office and used for billing purposes) as well as copies for others as required. The invoices are then placed in proper loading sequence.

From the invoices, tags which have the name of the wholesaler's firm printed thereon, are typed for each item in the order. That is, for an order consisting of three crates of lettuce and two boxes of apples, two tags are made, one showing three crates of lettuce and the other showing two boxes of apples. The name and address of the buyer or retail store is imprinted on the tag from an address-o-graph plate. The perforated tags for each invoice are joined together, so that they can be easily separated but kept in the proper order. After the tags are prepared, the invoices, in proper sequence, are placed on a clipboard, and, with the tags, are delivered to the warehouse foreman.

Assembling.--This method differs from the methods previously discussed in that items, as they occur on the orders, are picked from stock on four-wheel hand trucks in the sequence the orders are to be loaded onto the delivery truck, rather than in pallet or unit loads or in total quantities of each item needed for an individual delivery truckload.

The assembly crew consists of six members: Four assemble merchandise with four-wheel hand trucks, one splits packages, and one checks each hand truckload and affixes the tags to the packages. This latter member, when not busy checking hand truckloads, helps assemble produce.

^{12/} In the comparison of methods, which is covered in the next section of this report, labor and machine inputs for this method are adjusted to a single-story operation, since the five methods previously described were all in use in one-story buildings.

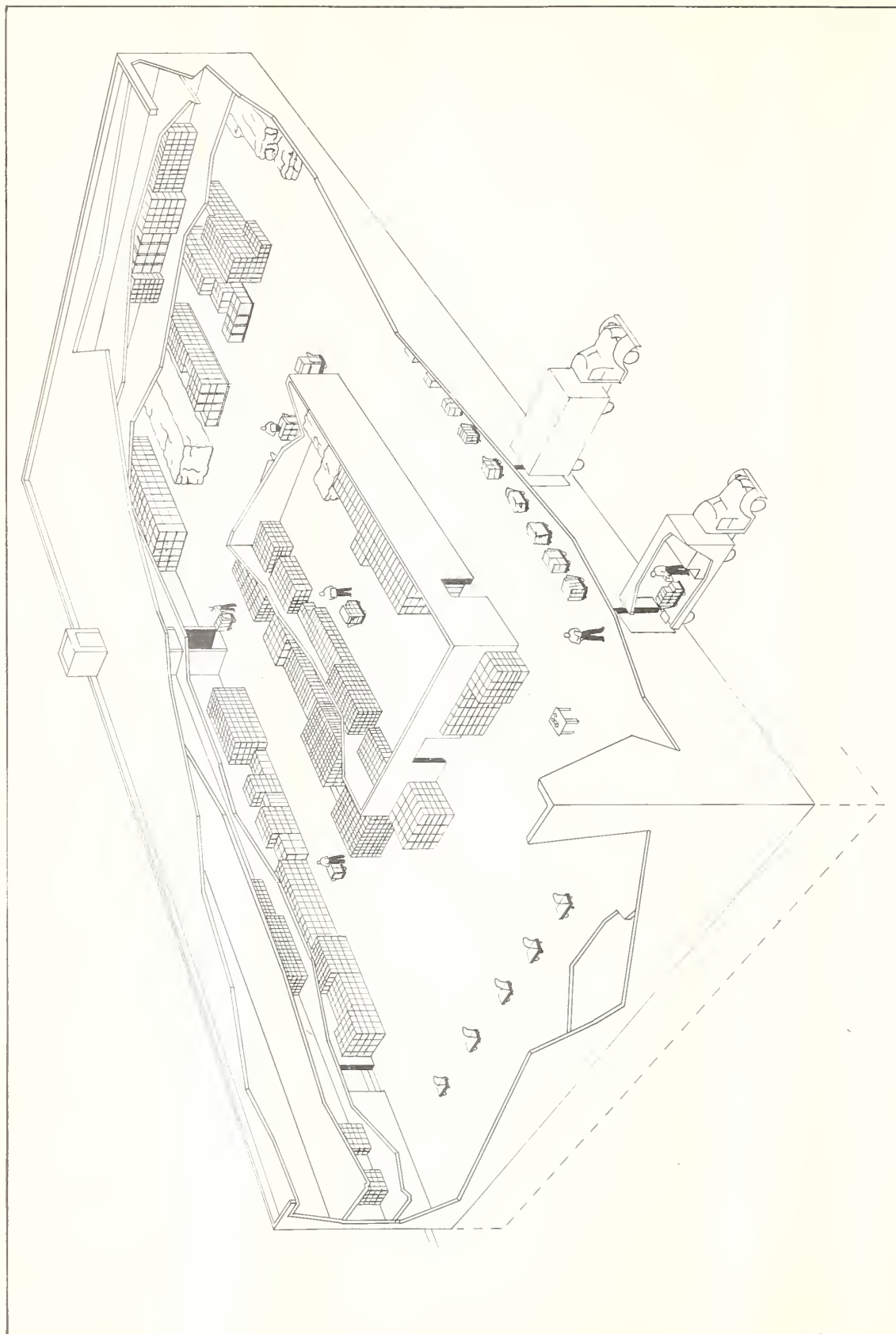


Figure 6.--Layout of a warehouse in which four-wheel hand trucks are used for assembling produce and loading motor trucks.

A relatively large number of four-wheel hand trucks are required for this method, the actual number depending on the number of crew members involved in assembly operations, the number and size of orders in a single motortruck load, and the number of loaded hand trucks that can be accommodated in the assembly area. In the light of these factors not fewer than three four-wheel hand trucks per worker in the assembly crew should be provided. This number should permit sufficient flexibility in the assembly operation to keep all labor continually employed in the entire cycle of loading-out operations. Additional four-wheel hand trucks are needed for moving merchandise from the basement and second floor to the first floor. The warehouse studied used a total of 30 of these trucks.

Invoices, on a clip board, and tags, both arranged in proper sequence, for each motortruck load, are delivered to the foreman one at a time. The tags, which are used by members of the assembly crew, are placed on a shelf conveniently near the route of travel of these workers. All items of call located on the first floor are conveniently stacked for easy access by the assembler as he travels his path.

For the produce items that are not stored on the first floor, working stocks are drawn from permanent storage on four-wheel hand trucks, which are brought from the basement and second floor to the first or main floor on the elevator. Merchandise brought from other floors to the first floor on the hand trucks is not off-loaded. The loaded hand trucks are placed in position on the first floor along the routes used by the assemblers.

An assembler first stops at the tag shelf and pulls sufficient tags of one or more products to make up an approximate four-wheel hand truckload. Beginning with an empty four-wheel hand truck the assembler moves along a route on the first floor that is determined by the number and the quantity of each item he is to assemble on that particular trip. As the assembler moves from one storage point to another along his predetermined route, he picks up and loads the items listed on the tags. For example, if he has two tags, one for one bag of potatoes and the other for three bags, he places four bags on the four-wheel hand truck. This routine is followed for all items for which he has tags. After the assembler has picked up all items for the tags, he pulls or pushes the loaded four-wheel hand truck to the area near the tail gate of the motortruck. The tags for that load are placed on top of the merchandise on the four-wheel hand truck. The trip ends when the assembler brings the loaded hand truck to the tail gate of the motortruck. He then revisits the tag shelf, picks up an empty hand truck, and repeats the cycle.

As they are loaded, the hand trucks should remain in the same sequence as the tags that were used to assemble the merchandise. This sequence is desirable but not essential, since the checker can determine when any of the hand trucks is out of position, a situation happening quite frequently under certain conditions. For example, if the tags selected for 1 hand truckload are for 1 or 2 items rather than for 10 items, less time is required to make the 1 or 2 stops than the 10 stops and, as a consequence

this truck moves in ahead of the other hand trucks. When a loaded hand truck arrives at the assembly area out of proper sequence, this situation is corrected by the checker.

At the motortruck tail gate or in the assembly area, a worker verifies by checking the items shown on the tags against the items on the four-wheel hand truck and affixes the tags to selected packages in the lot. The tags are attached to the wooden or other rigid containers with a hand stapling machine and to bagged items with a tag hook.

Package splitting is done by one full-time worker, who performs this work in the basement at a so-called "split bench." He makes up a selection of split packages and brings them to the first floor with a four-wheel hand truck. The packages then become working stock and are picked, as are full containers, by the assemblers.

Loading.--The motortruck-loading operation by this method required the fewest man-hours of labor per ton of any of the methods described because it was necessary in using this method to handle merchandise only once after it was assembled instead of twice as in other operations. No equipment other than the hand trucks used to assemble merchandise is used in loading the motortruck. To load it is necessary simply to push the hand truck onto the bed of the motortruck, off-load the hand truck, stow the produce, and push the empty hand truck back to the platform.

After the tags were affixed, the foreman, who is also the checker, checks the items assembled on each hand truck against those listed on the invoice and places a check mark beside each item as evidence that the merchandise is on the hand truck and that the order is accurately and completely filled. It is not necessary for the checker to call each item as with the other methods described.

Only one worker per motortruck is used in the loading operation. This worker merely pushes the first, or next, loaded hand truck onto the motortruck and stops it at a point that is most convenient for unloading. The load is pushed rather than pulled so that the handle of the four-wheel hand truck will not be in the way. All items are removed from the hand truck and stowed, care being exercised at all times to stow the items in the order that requires the minimum of rehandling. The empty hand truck is pulled out of the motortruck onto the floor of the warehouse, where it is again available to the assemblers. As the loading of each motortruck is completed, the loader moves to another location, where the next delivery truck is in position and loading is continued with very little break. As the second delivery truck is being loaded, a man, who divides his time between positioning and garaging the motortrucks and assisting with the loading, moves the first truck and replaces it with the next one, on which the third load for the night is to be placed. In other words, two loading points are used alternately throughout the night until the last motortruck is loaded. On nights of unusually heavy work loads, two delivery trucks may be loaded simultaneously.

Comments on Method

The various operations in the cycle are carried on smoothly and with little or no interference between different phases of the operation. For example, when there is an adequate number of four-wheel hand trucks, it is unnecessary for the assemblers to wait on the loader, and so long as there are sufficient assemblers to keep ahead of the loader, the loader does not have to wait. A good balance of crew is attained at the warehouse using this method. The crew consists of one foreman, four assemblers, one man verifying loads and affixing tags, one package splitter, and two loaders. Because of the independence of the various phases of work, the problem of balancing the operation is easily solved.

With this method all equipment is highly mobile and need not clutter up valuable platform space--a consideration that may be particularly important to a service wholesaler who operates on a terminal market where a number of dealers are located side by side in the same building. Use of this method would not block the common platform as would a conveyor.

Equipment costs are relatively small and the equipment can be used for a number of other materials-handling operations.

This method reduces to a minimum the number of times each package of produce is handled, which is particularly important in reducing handling costs and minimizing spoilage and deterioration. Stowing of the merchandise on the delivery truck is more expeditiously accomplished, since the loader can stow the items in the order he desires, rather than take them as they come down a conveyor.

Another advantage of this method is that packages for an individual dealer are identified with tags, thus making it easy for the truck driver to find the items at each delivery stop. Such identification of individual packages may also have some merchandising value, since a customer who receives delivery of an order knows that the packages marked for him at the warehouse are the ones delivered.

COMPARISON OF METHODS FOR LOADING OUT DELIVERY TRUCKS

Although all the methods of loading out delivery trucks previously described have been, for comparative purposes, adjusted to single-story operations and standardized transportation distances, direct comparisons between them are difficult, because labor and machine inputs for the various warehouses in which these methods have been studied were influenced by a number of factors not directly associated with the method. Some of these variables involve differences in: (1) The types and quantities of items handled, (2) quality of supervision, (3) varying tonnages loaded on individual motortrucks, (4) skill and effort on the part of the crews ^{13/}, (5) relation of platform heights to truck-bed heights, and (6) warehouse layouts and design features.

Because of these and other variables that influence production rates, it is not reasonable to expect that any one of these methods could be used in another warehouse with labor and equipment requirements identical to those discussed in this publication. The figures presented for the warehouses studied could be greater or less than those presented for each method.

A wholesaler who is interested in determining the labor and machine requirements for any one of these methods in his own plant should study the description of the method and the facility in which it is being used, and decide in what respects the method would have to be revised in order to adapt it to his plant. The wholesaler should then be in position to determine how nearly the costs shown for each method could be approximated in his own warehouse.

Labor requirements for performing the various operations in the cycle of loading-out operations and total labor costs (using assumed wage rates) are presented in table 1. It will be noted that, with one exception, all methods require more labor for assembly operations than for loading.

When Method D was used the total labor requirements per ton and as a result the labor cost for performing the cycle of operations were lower than under any other method, largely because the method of assembly used under Method D adheres very closely to sound materials-handling principles. In assembling merchandise all items (except specialty items) are brought to the assembly area in pallet loads. After the initial stock is brought out, assembly consists only of replacing empty pallets with full ones, and this

^{13/} Although all time study observations made to determine labor and machine inputs were "leveled," it is recognized that, for comparative purposes, this technique does not provide an entirely satisfactory tool for isolating and measuring the components of worker activity.

Table 1.--Comparative labor costs per ton for loading out delivery trucks of produce service wholesalers by use of 6 specified methods 1/
(Preliminary, subject to revision)

Method	:Time required: for assembly : 2/	:Time required: for loading : 3/	:Total time : 4/	:Avoidable: delays : 4/	:Total less: avoidable : delays : 5/	:Total labor cost 5/
	: <u>Man-hours</u>	: <u>Man-hours</u>	: <u>Man-hours</u>	: <u>Man-hours</u>	: <u>Man-hours</u>	: <u>Dollars</u>
A	: 6/ 0.75	: 0.44	: 1.19	: 0.03	: 1.16	: 1.74
B	: 7/ .60	: .43	: 1.03	: .06	: .97	: 1.46
C	: .65	: .73	: 1.38	: .03	: 1.35	: 2.02
D	: .45	: .37	: .82	: .03	: .79	: 1.19
E	: .91	: .56	: 1.47	: .05	: 1.42	: 2.13
F	: 7/ .66	: .28	: .94	: --	: .94	: 1.41

1/ The distance produce was moved from the point at which certain items are stored to the assembly area in the vicinity of the tail gate of the delivery trucks was standardized within a range of 75 to 95 feet.

2/ Consists of the labor required to remove from storage and move the various products from the coolers or storage area to the loading area. Also included is the labor required in making up split-package orders, in performing clerical work incidental to the assembly operation, and in cleaning up between loads and after the night's operation.

3/ Time spent calling items and placing packages in the delivery truck after assembly. Also included is the time spent driving the delivery trucks into and out of position (and garaging the trucks where necessary) and making ready for loading.

4/ Any delay not an inherent part of the operation.

5/ Based on a rate of \$1.50 per hour which includes wages, overtime, paid vacations, workmen's compensation, and other labor costs.

6/ Adjusted to allow for a reduction in transportation distance of 125 feet to 90 feet.

7/ Adjusted to the time which would have been used by this operation in a single-story building. The adjustment was made by subtracting an allowance for elevator time and the extra labor of handling individual packages caused by the multifloor facility from the actual observed times.

procedure insures efficient utilization of labor. Assembly operations performed by use of Method D required on an average 37 percent fewer man-hours of labor than were required under the other five methods.

From the standpoint of the loading operation, Method F, in which four-wheel hand trucks are used, required the lowest labor inputs per ton for loading of any of the six methods described. Under this method fewer handlings are necessary and the checking routine used in five of the methods are eliminated. As compared with Methods A, B, and D, which employ conveyors for loading and require about the same man-hours of labor per ton, Method F required 24 to 36 percent fewer man-hours per ton for the loading operation. Method C, showed the poorest results-- 0.73 man-hours per ton were required for loading, primarily because of facility difficulties that required two workers in the truck.

Under Method E, the highest labor requirements for both assembly and loading and the complete loading-out operation were recorded, and as a result, the greatest labor cost--\$2.13 per ton--or \$0.94 higher than under Method D, which had a labor cost of only \$1.19 per ton.

Per-hour ownership and operating costs for the types of materials-handling equipment used in the methods described are presented in table 2. Exclusive of pallets these costs ranged from a low of 0.33 cents for gravity conveyors to a high of 75.5 cents for the industrial trucks. These costs for a 30-foot length belt conveyor amount to 35.6 cents per hour of use.

To make valid comparisons of the six methods, the costs of owning and operating the equipment must be considered. These costs ranged from a low of \$0.02 per ton for Method F to \$0.44 for Method A (table 3). A relatively low equipment cost per ton was recorded under Method F because four-wheel hand trucks only are used. The costs for Methods A and D were relatively high because industrial low-lift platform and fork-lift trucks, hand low-lift platform and pallet trucks, and belt conveyors are used. Although methods A and D have high equipment costs per ton, labor requirements were 32 percent less with Method D than with Method A. The reason for the lower labor inputs with Method D is important. Method D makes full use of the fork-lift truck and hand low-lift pallet truck by assembling produce in unit loads. With Method A packages are handled on the skids singly in placing the produce during assembly. The relatively high equipment costs with Method D are largely offset by the low labor requirements per ton of produce loaded out.

The combined labor and equipment costs for each of the six methods are summarized in table 4. The costs shown are based on the productive man-hours of labor required in performing the loading-out cycle of operations. Idle and nonproductive time on the part of crew members in changing job assignments and other comparable delays are not included. Therefore, the costs shown are for use only in comparing the relative efficiency of methods. They are not intended to reflect actual costs in the warehouses

Table 2.--Per-hour ownership and operation costs for specified types of materials-handling equipment
(Preliminary, subject to revision)

Type of equipment	Initial: Annual: Expected:		Ownership costs		Operation costs		Total hourly
	cost : use : life :		Dollars		Dollars		ownership and
	Dollars	Hours	Years	Dollars	Dollars	Dollars	operation costs
2-wheel hand truck	30	2,000	10	4.95	0.0025	3.00	0.0015
4-wheel hand truck	50	2,000	10	8.25	.0041	6.00	.0030
Semilive skid and jack	50	2,000	10	8.25	.0041	6.40	.0032
Dead skids and low lift truck	45	2,000	10	7.43	.0037	3.60	.0018
Conveyor, gravity	40	2,000	10	6.60	.0033	---	---
Conveyor, belt (30 ft.)	1,500	1,000	10	247.50	.2475	108.25	.1083
Conveyor, belt, elevating (10 ft.)	600	1,000	10	99.00	.0990	96.40	.0964
Hand low-lift platform truck	3,500	2,000	10	577.50	.2888	234.00	.1170
Industrial low-lift platform truck	6,000	2,000	10	990.00	.4950	520.00	.2600
Industrial fork lift truck	6,000	2,000	10	990.00	.4950	520.00	.2600
Pallets (per 100)	350	2,000	5	93.00	.0465	---	---

1/ Based on depreciation over the expected life, 5 percent interest on investment plus an allowance of 4 percent for insurance and taxes.

2/ Annual costs divided by the hours of annual use.

3/ Data assume that for each 10 semilive skids, 1 skid jack is required.

4/ Data assume 1 low-lift truck for each 10 skids.

5/ The same figure used for straight and cantilever-type conveyors.

6/ Electric-powered.

Note: The hourly costs for operation of industrial-type equipment are based on figures developed by the Marketing and Facilities Research Branch in connection with a materials-handling study in other types of facilities. These costs for other battery-powered equipment were supplied by the Electric Industrial Truck Association.

Table 3.--Comparative equipment ownership and operation costs per ton for loading out delivery trucks of produce service wholesalers by use of 6 specified methods 1/ (Preliminary, subject to revision)

Method	2-wheel : hand : truck	4-wheel : hand : truck	Semilive : skid and : jack	Dead : skids and : low-lift : truck	Gravity : conveyor : (cantilever)	Belt : conveyor : (straight)	Belt : conveyor : (elevating)	Hand : low-lift : platform : (walkie)	Indus- : trial : low-lift : platform : truck 2/	Indus- : trial : fork : lift : trucks 2/	Total : equipment : Pallets : ment : costs : 3/
	Machine hours	Machine hours	Machine hours	Machine hours	Machine hours	Machine hours	Machine hours	Machine hours	Machine hours	Machine hours	Dollars
A	--	--	--	1.86	--	4/ 0.37	4/ 0.56	0.13	0.09	--	5/ 0.44
B	3.70	--	9.22	--	--	--	.11	--	--	--	.12
C	--	--	10.43	--	--	--	.14	0.14	--	--	.18
D	--	--	4.00	--	--	.08	.16	.09	--	0.16	80.00 .31
E	--	0.84	--	--	0.10	--	--	--	--	.14	52.20 .14
F	--	2.15	--	--	--	--	--	--	--	--	.02

1/ Machine hours per ton determined by multiplying average hours of use in loading-out operation by number of pieces of equipment, and dividing by number of tons loaded out.

2/ Electric-powered.

3/ Dollar cost per ton determined by multiplying the machine hours per ton involved for each type of equipment by the total hourly ownership and operation costs (table 2); the resulting sum of these products is the equipment cost per ton of produce loaded.

4/ Machine hours for the conveyors used in Method A are high because the equivalent of two complete sets of conveyors are used for each loading crew--while one set is in use, the other set is idle.

5/ Operating costs for conveyors in Method A are based on 50 percent utilization.

in which the methods were studied. In fact, the costs shown may be somewhat lower than costs computed by the wholesaler using accounting methods. Method F, which uses four-wheel hand trucks alone, showed the lowest cost--\$1.43 per ton of produce loaded out. Under Method D costs are \$1.50 per ton or 7 cents per ton higher than under Method F. Thus it can be seen that although Method D was the most efficient from the standpoint of utilizing labor, its total costs, because of high equipment expenses, surpassed those of another method. The costs under Method E--\$2.27 per ton--were higher than under any other method, and exceeded the cost under Method F by \$0.84 per ton. Although Method E employs some of the same types of equipment used in the better methods studied, the results obtained with it are the poorest because of the manner in which the equipment was used. Provided his facilities are suitable, a wholesaler who loads out 50 tons of produce per day could reduce his handling costs \$42 per day, or about \$13,000 per year by changing from Method E to Method F. This saving should more than compensate for the time and effort devoted to the establishment of a well-organized and efficient loading-out method.

Table 4.--Comparative costs per ton for loading out delivery trucks of produce service wholesalers by use of 6 specified methods
(Preliminary, subject to revision)

Method	: Cost of loading 1 ton of produce		
	: Labor 1/	: Equipment 2/	: Total
	: Dollars	Dollars	Dollars
A	: 1.74	0.44	2.18
B	: 1.46	.12	1.58
C	: 2.02	.18	2.20
D	: 1.19	.31	1.50
E	: 2.13	.14	2.27
F	: 1.41	.02	1.43
	:		

1/ Brought forward from table 1.

2/ Brought forward from table 3.

It should be pointed out that total costs shown in table 4 for Method F, which was observed and studied in a multistory building, are adjusted to make the data comparable to a one-floor operation. The adjustment made in labor used for assembly was conservative and there is little doubt that any wholesaler, owning a single-floor warehouse with properly designed platforms, would equal or exceed the performance indicated in this report by adopting this method. Low investment and high flexibility make Method F an attractive one; other methods require the handling of rather big volumes of produce to justify large outlays for the equipment needed. However, even the wholesaler who used the better methods, such as Methods B and D, would save the sums of \$7.00 and \$3.50 per night respectively, in loading out 50 tons.

DEVICES AND TECHNIQUES FOR IMPROVING LOADING-OUT METHODS

A number of devices and techniques offer possibilities for improving the methods of loading out produce currently used by service wholesalers. After a method for loading out has been established in a warehouse, the production rate for the method in most instances can be increased by using one or more of these aids. Although, individually, these devices and techniques may appear to be of minor importance, collectively they may mean the difference between good or poor results with the loading method.

Conveyor Equipment

When a belt-conveyor system is used in loading the delivery truck, a cantilever-type will give best results for the "main line" or section extending from the platform into the motortruck. With this type of conveyor it is unnecessary for the workers to push the conveyor wheels across the gap between the platform and the bed of the motortruck during set-up. Moreover, while the loading operation is under way, the conveyor can be positioned without the wheels coming in contact with the irregular truck bed. Truck beds are often rough, and provide poor running surfaces for the small wheels that support a conveyor. With the cantilever-type belt conveyor, the wheels remain on the loading-out platform, and less effort is required to place the conveyor in position. Differences between the heights of the motortruck bed and the platform do not affect the positioning of the cantilever-type conveyor as they would with other types.

A belt-conveyor loading operation usually can be made more efficient and greater flexibility can be obtained by affixing a 3-foot section of gravity-type roller conveyor to the motortruck end of the belt conveyor (fig. 7). A stop should be affixed to the end of the roller conveyor so that as items reach the end of the belt conveyor they will roll off onto the roller conveyor and be held there until the truck loader can remove them. This simple, inexpensive, and easily installed device permits the truckman to give greater attention to the stowing of the packages, since the packages will not fall onto the floor as they reach the end of the belt conveyor line. Moreover, it will eliminate or minimize the breaking of packages and the bruising of produce, and permit the loader to work at a more steady pace.

Another aid that should be provided for the truckman is a start-stop switch on the motortruck end of the belt conveyor that will permit him to control the rate of flow of the conveyor. If items are coming to him too fast, the loader can cut the power at the proper moment and stop the packages from moving into the truck. As soon as he has caught up, the power can be turned on and the movement resumed.

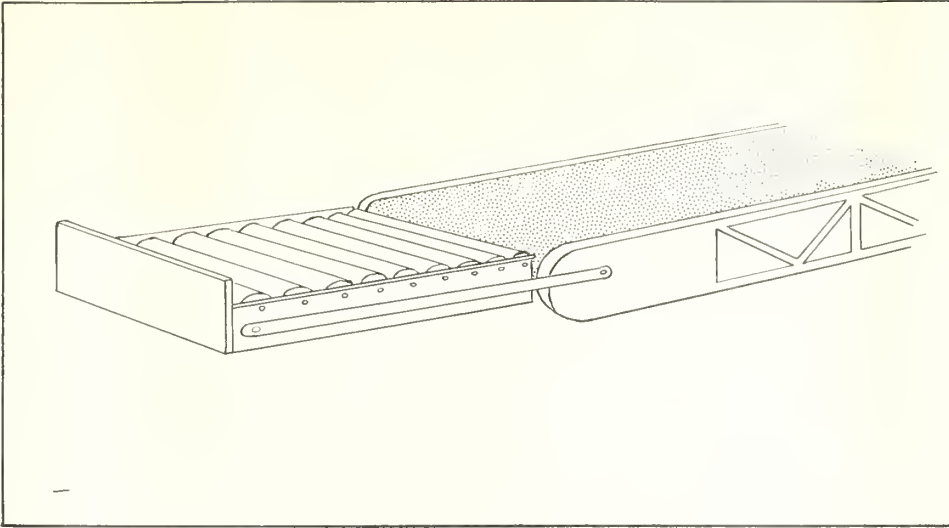


Figure 7.--Roller conveyor section attached to truck end of belt conveyor

Flexible Crew Arrangement

No loading method should be so inflexible that crew members cannot be readily reassigned to meet new and different conditions that may arise. For example, during nights on which heavy volumes of produce are loaded it may be desirable or necessary to use two workers in the motor truck rather than one, in order to load the volume in time for morning delivery. Or, it may become necessary from time to time to shift a worker from one job to other unrelated work. Such shifts should be possible without seriously handicapping the productivity of the other crew members. However, it is not, as a rule, good practice to vary the crew size and arrangement after the work pattern has been established, since this may introduce a problem in balancing the workload.

When changes in the crew assignments are required, these should be so made that the remainder of the operation will not be disturbed. The work should be distributed among remaining crew members in such a way that one worker will not create a bottleneck for the entire operation.

Where assembly-line methods are used in loading delivery trucks and initial assembly operations in stocking the line require considerable time, two workers should report for work in advance of the majority of the crew to perform initial assembly operations. This procedure reduces the overstaffing of initial assembly operations that occurs when all the night men start work at the same time.

Split Packages

The practice of splitting packages, a service provided customers by a number of wholesalers, is expensive and time consuming. Considerably more labor is required to assemble a given volume of produce in split packages than in original packages. However, there are possibilities of reducing the labor requirements for package-splitting operations.

The sizes of split packages should be standardized whenever possible. That is, less-than-full packages of specific produce items should be sold only in certain established quantities; for example, crates of carrots might be split into units such as: 1 dozen, 2 dozen, 4 dozen, and half a crate. Hampers of green beans might be split in 5- and 10-pound units. By standardizing the quantities of less-than-package lots, considerable package splitting work can be shifted to the day crew. Although the day crew will not know the exact number of split packages that will be needed, a reasonable number of packages of various items can be prepared, and with experience they should be able to pack about the number needed each night. If additional packages are needed, they would, of course, have to be packed by the night crew. In most warehouses there are periods during the day when the available work is not sufficient to fully occupy the time of the entire crew. Such periods might well be utilized in packing less-than-full package lots.

A number of wholesalers sell half boxes of California citrus fruits which they frequently prepare by opening a standard box on one side, taking out half the fruit and placing it in another box or crate. This is an inefficient and space-consuming method. A more efficient method of performing this operation capitalizes on the wooden separator in this type of box. One side of the box is tied and the top, sides, and bottom are sawed in two on the tied side of the separator, thus making two half units that are made ready for delivery. ^{14/} In at least one warehouse a power saw is used for halving wooden boxes and crates. The container is placed on end and a wire tightened about the container immediately below the center board as separator. The saw is then applied to the boards between the wire and the separator. After the container has been sawed in two, both halves are ready for loading.

In a number of warehouses, package-splitting operations might be further improved by use of the small-order container shown in figure 8. Such a container can be built at a relatively small cost on a semilive skid, a dead skid, or a four-wheel hand truck. The bins on the one side are used to hold the packages from which produce is taken to make up split orders. The bins on the other side are used to hold split packages. This

^{14/} A complete discussion of this method with illustrations was presented in Service Wholesaler Division Bulletin No. 97, December 15, 1951, published by United Fresh Fruit and Vegetable Association, 4 pp., illus.

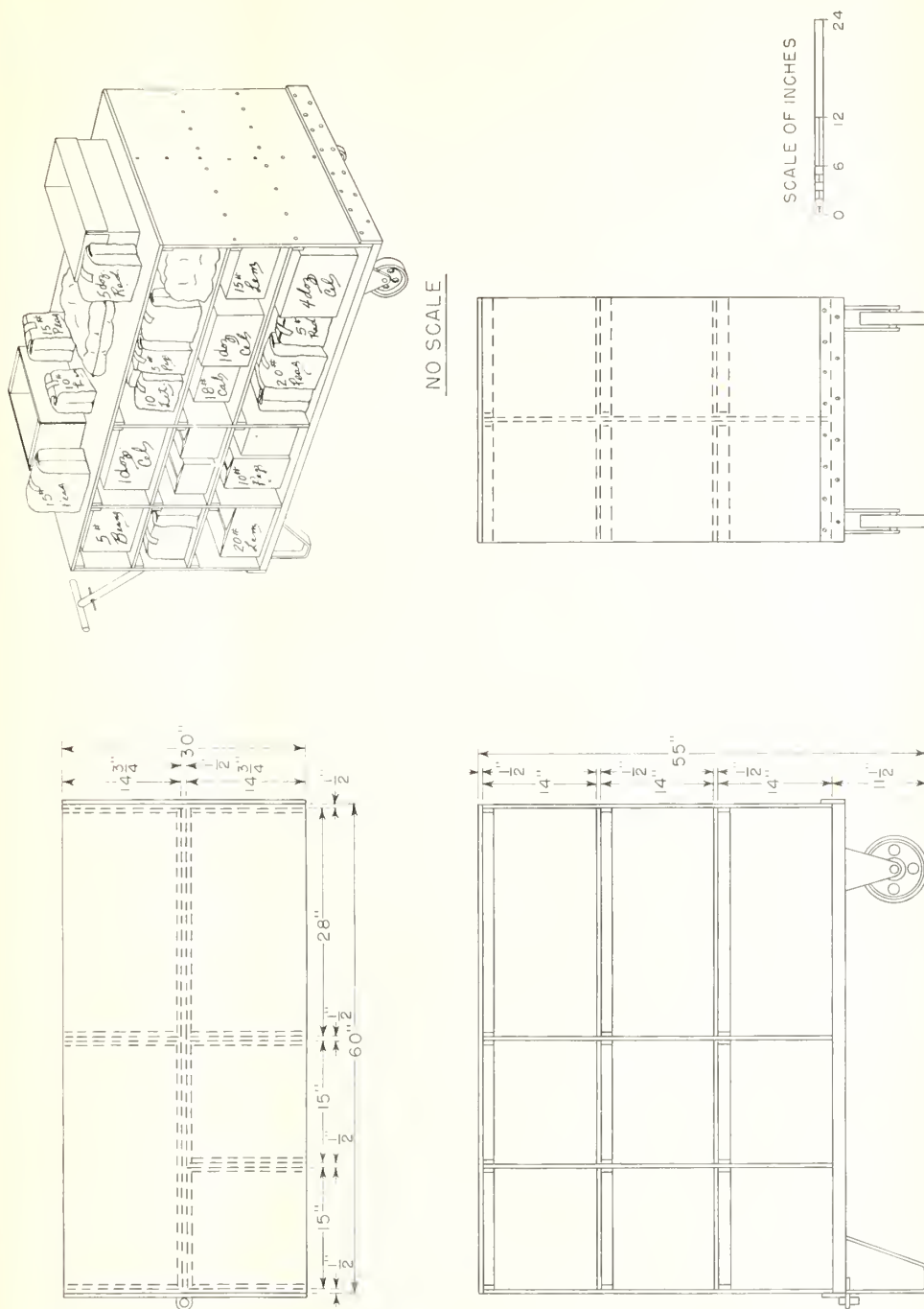


Figure 8.--Suggested plan for a split-package bin arrangement. (The dimensions can be changed easily to meet individual requirements.)

bin arrangement places all the produce needed for the package-splitting operation in a single compact unit, which minimizes the searching for open packages of produce. The loader also knows where to find the split packages as soon as the checker calls for them.

Loading the Conveyor Belt

As items are assembled for loading, they should be deposited about the tail gate of the motortruck in a prearranged and systematic order. During all assembly operations each item should occupy the same space on the platform. The workers placing items on the belt conveyor will soon learn the locations of the various items and will spend much less time searching for them if they are in the same space each night. The checker can help by calling off items, as nearly as possible, in the same order in which they are arranged on the floor. By so doing, the walking required in placing the produce on the belt conveyor can be reduced by working on one side from one end of the line to the other end, and then back on the other side. The practice of having workers walking up and down the line searching for the items called is costly and inefficient.

When a checker is to be employed, his work will be more accurate and less time consuming if he has a properly constructed stand, made portable with casters, on which to place invoices. Although the stand may be simple in design, it should be built to the checker's specifications.

Illuminating the Bodies of Delivery Trucks

The truck loader is in position to set the pace for the entire cycle of loading-out operations. He must handle each item loaded out, and he must stow them in the delivery truck so that they will be accessible and in good condition at the delivery points. His job will be expedited if an extension light is placed inside the motortruck body so that his work area is well lighted.

Working Conditions

The conditions under which men work strongly affect their productivity. This factor too often receives little or no consideration. Loading delivery trucks is fatiguing work. A break midway in the period before lunch and midway in the period after lunch should be authorized. This practice will reduce fatigue and increase workers' productivity. The workers should take their break simultaneously rather than one at a time; when one or two men rest while the others continue to work the crew balance is upset, and the productivity of the crew is materially lowered.

Sufficient heat should be provided in the warehouse during extremely cold weather since the cost of labor lost by the workers attempting to warm

themselves occasionally will be greater than the cost of fuel necessary to heat the warehouse. Men cannot do their best work if they are not comfortable. Care must be exercised not to overheat, since this might have bad effects on the perishables.

Good housekeeping should be a practice in every warehouse. Equipment, when not in use, should be stored out of the way but always in the same place. Floors should be kept clean and free of debris. Aisles and passageways should be kept clear and free of hazards. When a crew finishes work it should not be dismissed until the warehouse has been put in order. Keeping the work area neat contributes to efficiency.

Recording and Transcribing Equipment

The use of recording and transcribing equipment in loading delivery trucks has been tested and found to have considerable merit. The method of using this equipment is described in Agriculture Information Bulletin No. 43, Use of Recording and Transcribing Equipment in Loading Delivery Trucks of Produce Wholesalers, U. S. Department of Agriculture, Washington 25, D. C.



